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DOI:

[10.1111/jgs.15710](https://doi.org/10.1111/jgs.15710)

Document Version

Peer reviewed version

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Citation for published version (APA):

Sutton, J. L., Gould, R. L., Coulson, M. C., Ward, E. V., Butler, A. M., Smith, M., Lavelle, G., Rosa, A., Langridge, M., & Howard, R. J. (2018). Multi-component frailty assessment tools for older people with psychiatric disorders: A systematic review. *Journal of the American Geriatrics Society*.
<https://doi.org/10.1111/jgs.15710>

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Title Page:

Title: Multi-component frailty assessment tools for older people with psychiatric disorders: A systematic review

Short running title: Frailty assessment and psychiatric disorder

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23 **Twitter handles:** Robert J. Howard @ProfRobHoward

24 **Word Count:** Abstract: 228 words. Main Text: 3800 words. Number of figures in main text:

25 1. Number of Tables in main text: 2

26 **Funding Source:** None.

27 **Impact statement:** We certify that this work is novel. To the authors best knowledge this is
28 the first systematic review to consider frailty assessment in the context of psychiatric
29 disorder in older adults. This review highlights that no existing multi-component frailty
30 assessment has been developed for or validated in older adult populations with psychiatric
31 disorders. It also highlights that significant construct overlap and potential confounding
32 exists between the indicators of frailty as conceptualised in existing frailty assessment tools
33 and DSM-5 diagnostic criteria for common psychiatric disorders, including Major Depressive
34 Episode and Generalised Anxiety Disorder. It determines that further research is necessary
35 to establish a reliable and valid tool to assess frailty in this population.

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45 **ABSTRACT:**

46 **Objective:** To review evidence evaluating the use of multi-component frailty assessment
47 tools in assessing frailty in older adults with psychiatric disorders. **Methods:** A systematic
48 literature review was conducted to identify all multi-component frailty assessment tools (i.e.
49 a tool that assesses ≥ 2 indicators of frailty). The items of each frailty assessment tool were
50 compared to DSM-5 diagnostic criteria for psychiatric disorders to assess construct overlap.
51 Studies conducted in community, inpatient and outpatient clinical settings were considered
52 for inclusion. **Participants:** Adults aged ≥ 60 years old. **Results:** 5,639 records in total were
53 identified following the removal of duplicates; from which 95 studies were included for
54 review. Of the 48 multi-component frailty assessment tools identified, no tool had been
55 developed for, or validated in, older adult populations with psychiatric disorder. 20/48
56 frailty assessment tools contained a psychological assessment domain, with 17/48 tools
57 citing presence of depressed mood and/or anxiety as a frailty indicator. Common areas of
58 construct overlap in frailty assessment tools and DSM-5 diagnostic criteria included weight
59 loss (29/48) and fatigue (21/48). **Conclusions:** Significant construct overlap exists between
60 the indicators of frailty as conceptualised in existing frailty assessment tools and DSM-5
61 diagnostic criteria for common psychiatric disorders, including Major Depressive Episode
62 and Generalised Anxiety Disorder, which has the potential to confound frailty assessment
63 results. Further research is necessary to establish a reliable and valid tool to assess frailty in
64 this population.

65 **Keywords:** frailty assessment, psychiatric disorder.

66 INTRODUCTION:

67 Frailty is a prevalent issue in later life, with evidenced links to adverse outcomes including
68 functional decline, falls, institutionalisation and mortality.¹⁻⁵ Frailty is a multifactorial clinical
69 state or syndrome; it represents decline in multiple physiological systems resulting in poor
70 maintenance of homeostasis and decreased reserves and resilience to stressors^{6,7}. There are
71 number of models to conceptualise frailty, the two most widely accepted being the
72 Canadian Study of Health and Ageing Cumulative Deficit Model⁸ and the Cardiovascular
73 Health Study Phenotype Model⁹. The Cumulative Deficit Model assesses frailty through an
74 index of deficits associated with aging including disabilities and diseases; a higher index
75 score indicates a higher level of frailty, with no cut point to distinguish between frail and
76 robust⁸. The Phenotype Model establishes a frailty phenotype consisting of the following
77 frailty indicators; involuntary weight loss, self-reported exhaustion, self-reported sedentary
78 behaviour, slow gait speed and weak grip strength⁹. The presence of zero frailty indicators
79 suggests an individual is robust, 1-2 frailty indicators is suggestive of pre-frailty (the
80 intermediate stage between robust and frail) and ≥ 3 indicators confirms frailty¹⁰.

81 Frailty and psychiatric disorders, such as Major Depressive Disorder and Generalised Anxiety
82 Disorder, are thought to be distinct but highly related clinical entities.^{11,12} Evidence suggests
83 that frailty and psychiatric disorders are highly co-morbid^{12,13}. A recent systematic review of
84 evidence exploring comorbidity of frailty and depression found that 4-16% of frail adults
85 aged ≥ 60 years had major depression, with this rising to 35% in frail older adults aged ≥ 75
86 years and in male populations.¹³ The rate of co-morbid frailty in depressed older adult
87 populations reached 46-57%.¹³

In addition to comorbidity there is good evidence to support a bidirectional association between depression/anxiety and frailty in later life.^{12,14-16} Evidence suggests that older adults with a psychiatric disorder are at an increased risk of becoming frail and often experience the highest levels of frailty.^{17,18} For example, a cross sectional observational study by Collard and colleagues¹⁹ found that the overall prevalence of physical frailty in a depressed older adult population was 27.0%, three times higher than the prevalence in the study's non-depressed sample (9.1%). Conversely, evidence suggests that frailty is associated with an increased chance of developing clinically meaningful depression and anxiety symptoms.^{12,14-16} Further to this, physical frailty has been shown to adversely affect the course of late-life depression, with increased odds of non-remission associated with increased physical frailty²⁰. Brown and colleagues²¹ have recently proposed a depressed frail phenotype as a high-risk profile for late life frailty. Given that psychiatric disorders are also pervasive late life issues with increased risks for many of the same adverse outcomes as frailty including dementia and mortality,^{22,23} frailty in the context of psychiatric disorder warrants specialist clinical detection and intervention.

Frailty is widely considered to be a dynamic process with potential for restorative and preventative clinical interventions.^{6,24} The need to develop new treatment modalities to address frailty in the context of psychiatric disorders has been recently highlighted^{13,25}. The accurate assessment of frailty is key in the development and provision of such interventions. A recent systematic review of the psychometric properties of existing multi-component frailty assessment tools found the extent and quality of psychometric testing of these tools to be limited²⁶. Only two of the thirty-eight tools included for review evidenced reliability and validity data within statistically significant parameters and were of fair-to-excellent quality according to the COnsensus-based Standards for the selection of health

Measurement INstruments (COSMIN) checklist²⁷; the Frailty Index-Comprehensive Geriatric Assessment (FI-CGA)²⁸ and the Tilburg Frailty Indicator (TFI)²⁹. To date, there is no frailty assessment tool that is widely accepted as a gold standard.²⁶

Given the high co-morbidity of frailty and psychiatric disorders in late life, associations between the two, the increased risk for adverse outcomes and potential for restorative and preventative interventions, the accurate assessment of frailty in older adult psychiatric populations should be a priority. Of the 10 systematic reviews concerning frailty assessment published to date,^{7,26,30-37} none have considered frailty assessment in the context of mental illness. Therefore, the aims of this review were to: (1) Establish if any existing multi-component frailty assessment tools have been developed for or validated in older adult populations with a diagnosis of psychiatric disorder, and (2) establish any construct overlap between the assessment domains of existing multicomponent frailty assessment tools and the Diagnostic and Statistical Manual of Mental Disorders (DSM–5) diagnostic criteria for psychiatric disorders in older adults, exploring the potential impact of this on valid and reliable frailty assessment in this population.

METHODS:

Search strategy

The following databases were searched on 15th February 2017: Medline (1946–present), PsychINFO (1806–present), Embase (1947– present) and the Cochrane Central Register of Controlled Trials. The search strategy used was: frailty AND (older OR elder* OR geriatr*) AND (measure* OR assess*). The reference lists of 10 systematic reviews^{7,26,30-37} concerning

134 frailty assessment identified through the above search strategy were also searched
135 manually.

136 Selection criteria

137 Studies were selected for inclusion for review if they met the following criteria:

- 138 • All study participants were aged ≥ 60 years old.
- 139 • The study described a multi-component tool, which was defined as a tool that
140 assesses ≥ 2 indicators of frailty, such as a frailty index.
- 141 • The study described a tool that was specifically developed to assess frailty.
- 142 • The main purpose of the study was the development and/or evaluation of the
143 reliability and validity of a multi-component tool to assess frailty.
- 144 • The study applied the original version of a multi-component tool to assess frailty.
- 145 • The full content of the multi-component tool was available (including all indicators of
146 frailty, units of measurement and scoring systems).
- 147 • The study reported quantitative data.
- 148 • The full peer-reviewed study text was available.
- 149 • Studies were available in English or were translated wherever possible.

150 See supplementary file 1 for an expanded explanation of study selection criteria. The title
151 and abstracts were screened, and potentially eligible studies were selected for inclusion by
152 JLS. Studies were considered for inclusion regardless of their methodological quality.

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Data extraction and analysis

Data were extracted regarding: i) study characteristics; ii) the population each tool was developed for and validated in; iii) the content of each frailty assessment tool. Data for items i) and ii) were extracted by two independent raters, while data for item iii) were extracted by JLS.

Following data extraction, the assessment items of each frailty assessment tool were compared to the DSM–5 diagnostic criteria for the seven common psychiatric disorders in older adults; Major Depressive Disorder (MDD), Bipolar Affective Disorder (BAD), Schizophrenia, Generalised Anxiety Disorder (GAD), Social Anxiety Disorder (SAD), Specific phobia (SP) and Panic Disorder (PD).^{22,38} An assessment of definite construct overlap between the items of the frailty assessment tools and the DSM-5 diagnostic criteria was then completed. Definite construct overlap was defined as instances where the frailty assessment tool item and DSM-5 diagnostic criteria were conceptually the same (for example, ‘troubles with sleeping’ and ‘Insomnia or hypersomnia’). The exact units and process of measurement did not need to be the same, but they must have assessed the same theoretical construct. The potential for an individual to be assessed as frail or pre-frail based on mental health symptoms alone was also reviewed. Assessment of definite construct overlap was completed by two independent blind raters (JLS, RLG, MCC, EVW, AMB, ML, MS, AR). Any disagreements were resolved through discussion.

Assessment of methodological quality of studies included for review

The COSMIN checklist is a standardized tool for evaluating the methodological quality of studies examining measurement properties of health-related instruments.^{27,39,40} It assesses measurement properties across the following domains, awarding ratings of ‘excellent’,

‘good’, ‘fair’, or ‘poor’ quality; internal consistency, reliability, measurement error, content validity, structural validity, hypotheses testing, cross-cultural validity, criterion validity and responsiveness.^{27,39,40} A rating of ‘excellent’ indicates that the evidence provided for that measurement property is adequate. A rating of ‘good’ indicates that the evidence provided can be assumed to be adequate. A rating of ‘fair’ indicates that the evidence is questionable, and ‘poor’ indicates that the evidence provided is inadequate. The COSMIN checklist was applied to each study and data were extracted by two independent, blind raters (JLS, RLG, MCC, AMB, EVW, MS, GL). Any disagreements were resolved through discussion.

Reporting

This review followed the PRISMA standards⁴¹ for reporting of systematic reviews.

RESULTS:

Literature search and inclusion for review:

The literature search identified 5,639 records in total following the removal of duplicates; from which 95 studies were included for review following assessment against selection criteria (see Fig. 1).^{3,9,28,29,42-132}

Study characteristics

A full outline of study characteristics is provided in supplementary table 1. Forty-eight multi-component frailty assessment tools were examined across 95 studies.^{3,9,28,29,42-132} The most frequently observed study design was prospective cohort (32/95 studies).^{3,9,42-46,48-51,59,70-72,74,75,80,82,86,89,91,94,97,99,103,107,109,116,118,131,132} Of the 62 studies with follow-up data available,

follow-up periods ranged from 1 month^{53,64,73} to 348 months.¹¹⁹ The total number of participants per study ranged from 14¹²¹ to 931,541.⁶⁷ The overall total percentage of female participants, calculated by pooling the percentage female population from the 84/95 studies with data available, was 65.9%. The overall mean age of participants, calculated by pooling the mean ages from the 73/95 studies with data available, was 74.9 years. Participants were most commonly sampled from The Netherlands (29/95 studies).^{29,60-62,68,76,77,84,86-92,95,96,98,101,102,107,111,113-115,125-128} The cohorts were predominantly community based, general older adult populations (51/95).^{3,9,29,42,46,48,50,56-58,60-62,67,69,70,74,76,77,79,81,82,84-88,90,95-99,103,105,106,108,109,111,118,119,123-132} Only one of the 95 cohorts consisted of 'psychogeriatric patients' (80.8% diagnosed with dementia, 5% depression, 11% unspecified, 3% no mental disorder).¹⁰⁷ Data regarding participant mental health diagnoses were not available in the remaining 94 studies.

Methodological quality of studies included for review

The COSMIN checklist results are detailed in supplementary table 2. In total, 7/95 studies had one aspect of methodological quality rated as excellent.^{48,56,59,84,99,111,132} All ratings of excellent were in relation to content validity. A further 7/95 studies^{67,73,88,101,103,122,123} had at least one aspect of methodological quality rated as good; hypothesis testing being the measurement property with the highest number of good ratings (4/7). 70/95 studies had at least one aspect of methodological quality rated as fair.^{3,9,28,29,42,44,45,47,48,51-60,62,64,66,69-72,74-77,81-87,89-99,101-103,106,107,109-118,120,124,125,127-129} Hypothesis testing had the greatest number of fair ratings (65/70). 42/95 studies had at least one aspect of methodological quality rated as poor.^{43,46-50,52,53,57,58,60,61,63,65,68-70,76,78-80,82,84,86-88,91,98-100,104,105,108,111,112,115,118,119,121,126,129,130}

221 Criterion validity had the greatest number of poor ratings (30/42). Five studies cited low
 222 response rates as a study limitation.^{29,76,125,126,128}

223 Construct overlap between multi-component frailty assessment tool items and psychiatric
 224 disorder

225 Table 1 summarizes key findings in relation to the review aims. Table 2 provides an overview
 226 of construct overlap observed in relation to frailty assessment domains and supplementary
 227 table 3 provides an overview of all construct overlap observed. Of the tools reviewed, only
 228 7/48 had no definite construct overlap between frailty assessment tool items and DSM-5
 229 diagnostic criteria for MDD, BAD, Schizophrenia, GAD, SAD, SP or PD; Brief Clinical
 230 Instrument to Classify Frailty,⁴²⁻⁴⁴ Clinical Frailty Scale (CFS),⁴⁸⁻⁵¹ Frailty predicts death One
 231 year after Cardiac Surgery Test (FORECAST),^{54,55,73} Frailty Index Based on Common
 232 Laboratory Tests (FI-LAB),⁷⁵ Korean Longitudinal Study of Health and Aging (KLoSHA) Frailty
 233 Index,⁹⁹ Palumbo Frailty Index,¹⁰² and the 9-Item Frailty Measure.¹³² In 29/48 tools, definite
 234 construct overlap was established between the nutritive domains of the frailty assessment
 235 tool (weight loss/reduced appetite) and DSM-5 diagnostic criteria for MDD and BAD³⁸
 236 concerning weight loss and appetite changes.<sup>3,9,28,29,43,44,47,52,59,63-67,70-72,76-79,81,82,84-98,100,101,103-
 237 106,108,109,111-131</sup> Definite construct overlap was observed between frailty items concerning
 238 fatigue and the DSM-5 diagnostic criteria for MDD, BAD and GAD³⁸ concerning fatigue in
 239 21/48 tools.^{3,9,28,43,47,52-55,68,69,76-79,81,83,85,87,93,97,103-105,108-118,121-131} In 9/48 tools, definite
 240 construct overlap was established between cognitive items relating to concentration and
 241 processing skills and the DSM-5 diagnostic criteria for MDD, BAD and GAD,³⁸ concerning
 242 diminished ability to think or concentrate.^{28,44,45,67,70-72,76,77,80,87,100,107,119-130} Definite construct
 243 overlap was observed between the frailty item 'slowness' and psychomotor retardation; a

244 DSM-5 diagnostic criteria for MDD, BAD³⁸ in 8/48 tools.^{3,9,43,53-55,82,103-105,107-109,111-115} Definite
 245 construct overlap was observed between frailty indicators concerning reduced activity levels
 246 and the DSM-5 diagnostic criteria for schizophrenia,³⁸ concerning negative symptoms in
 247 8/48 tools.^{39,50-52,64,65,77,82,105-108,111,114-118} Definite construct overlap was also identified
 248 between sleep disturbance domains and the DSM-5 diagnostic criteria for MDD, BAD and
 249 GAD,³⁸ concerning sleep disturbance in 4/48 tools.^{47,67,74,76,77} A detailed summary of all
 250 construct overlap between all 48 frailty assessment tool items and DSM-5 diagnostic criteria
 251 for MDD, BAD, schizophrenia, GAD, SAD, SP & PD is provided in Supplementary tables 4-10,
 252 respectively.

253 Of the 31 tools for which there is a clear cut-off point to distinguish between individuals
 254 who are frail or robust, an individual could be classified as frail solely on the basis of their
 255 mental health symptoms in 11/31 tools,^{3,9,28,43,44,70-72,78,79,100,103-105,107-109,116-120} and as pre-
 256 frail on a further 5/31^{45,58,81,110-115} (16/31total).

257 20/48 multi-component frailty assessment tools identified in this review contain a
 258 psychological assessment domain (domains/items concerning 'psychological indicators of
 259 frailty' defined by the author).^{28,43-47,52,56,57,59-66,68-72,76-78,,84-92,94,100,101,109,110}
 260 17/48 tools include the presence of depressed mood and/or anxiety as specific
 261 measurement items indicating frailty.^{28,43-47,52,56,57,59-66,68-72,76,77,,84-92,94,100,101} 11/48 tools
 262 include items from existing psychiatric assessment tools; five of which use items from the
 263 Centre for Epidemiological Studies-Depression Scale (CES-D).^{3,9,43,58,68,79,104,105,108} Other tools
 264 included the Hospital Anxiety and Depression Scale (HADS)⁵⁹ and the Beck Depression
 265 Inventory II.⁹⁴ However, in the majority of these cases, items included from existing mental

health tools were used to assess fatigue (6/12),^{3,9,43,58,68,79,93,104,105,108} rather than the presence of mental illness (5/12).^{28,44,45,63,70-72,94,100}

DISCUSSION:

To the authors' knowledge, this is the first systematic review that has considered frailty assessment in the context of psychiatric disorder in older people.

In summary, no tool identified in this review has been developed for or validated in older adult populations with psychiatric disorder. One tool that has been tested in a psychogeriatric population; the Prognostic Risk Score,¹⁰⁷ was developed for and validated in a cohort of whom 80.8% had a dementia diagnosis. This identifies a gap in the current research.

Only seven tools were identified as having no definite construct overlap with DSM-5 diagnostic criteria: Brief Clinical Instrument to Classify Frailty⁴²⁻⁴⁴ and CFS,⁴⁸⁻⁵¹ which are screening instruments designed for use in general hospitals; FORECAST^{54,55,73}, which was designed to assess frailty following cardiac surgery; FI-LAB⁷⁵, which is based on common laboratory tests for use in long-term residential care facilities; KLoSHA Frailty Index⁹⁹, developed for use with community-dwelling elderly Korean population; Palumbo Frailty Index¹⁰², designed to assess frailty in multiple myeloma patients; and 9-Item Frailty Measure¹³², designed for use in routine geriatric practice. However, as noted, none of these tools have been developed for use in a mental health setting, or with consideration for the complex interactions between frailty and psychiatric disorder. Significant construct overlap was identified between indicators of frailty as conceptualised in existing frailty assessment tools and DSM-5 diagnostic criteria for seven common psychiatric disorders. The diagnostic criteria for MDD (and thus the depression criteria for BAD) had the highest proportion of

definite construct overlap with frailty assessment items (41/48 tools). The diagnostic criteria for GAD also had a high proportion of definite construct overlap (34/48 tools). The diagnostic criteria for SAD and SP had the lowest proportion of definite construct overlap observed (12/48 tools and 11/48 tools respectively).

20/48 frailty assessment tools contained a psychological assessment domain, with 17/48 tools including the presence of depressed mood and/or anxiety as a frailty indicator. The frailty indicators and DSM-5 diagnostic criteria that had the most construct overlap concerned weight loss (29/48 tools) and fatigue (21/48). This construct overlap was further confounded by the inclusion of questions from existing psychiatric assessment tools to assess fatigue in 6/48 tools. For the tools for which there is a clear cut-off point to distinguish between individuals who are frail or robust; an individual could be classified as frail or pre-frail solely based on their mental health symptoms in half of them (16/31 tools). This thus demonstrates significant potential for inaccurate assessment and recognition of frailty in psychiatric populations.

Specifically, significant construct overlap and confounding was observed for the frailty assessment tools with the most extensive reliability and validity testing;²⁶ FI-CGA²⁸ and TFI²⁹. FI-CGA²⁸ items such as ‘problems with mood’, ‘problems with motivation’ and ‘changes in weight’ were observed to have definite construct overlap with DSM-5 diagnostic criteria for MDD. On FI-CGA²⁸ it is possible to be assessed as frail based on psychiatric symptoms alone; the tool contains a psychological assessment domain and utilises questions from the Geriatric Depression Scale¹³³ to assess mood, further increasing confounding. TFI²⁹ items such as ‘unexplained weight loss’, ‘physical tiredness’ and ‘feeling down’ were observed to have definite construct overlap with DSM-5 diagnostic criteria for MDD. The TFI also

includes a psychological assessment domain. Whilst it is not possible to be assessed as frail based purely on the definite construct overlap observed for TFI, the level of overlap is such that it is likely to confound frailty assessment in psychiatric populations. Definite construct overlap was also observed for tools based on the prominent Cumulative Deficit Model⁷⁴ and Phenotype Model⁹, increasing the risks of confounding when assessing frailty with these tools in psychiatric populations.

It is of note that there were many frailty assessment items for which a direct plausible association with DSM-5 diagnostic criteria was observed, but which did not meet the criteria for definite construct overlap. For example, tools such as the FI-LAB⁷⁵ contain a measure of serum albumin as part of a nutritive domain, with low levels indicating malnutrition. Whilst this cannot be classified as definite construct overlap with the MDD diagnostic criterion 'unintentional weight loss', there is a direct and plausible association. Tools such as the Brief Frailty Index⁴⁵ and Prognostic Risk Score¹⁰⁷ included 'low body mass index' as an indicator of frailty, which again whilst highly associated with 'unintentional weight loss', did not meet the criteria for definite overlap. Another example are tools such as the Palumbo Frailty Index¹⁰² and the KLoSHA Frailty Index⁹⁹ which include a functional assessment of instrumental activities of daily living (IADL). Whilst no definite construct overlap was identified, there is a plausible association between IADL assessment performance and the symptoms of fatigue and reduced interest in activities and concentration associated with MDD.

Research and clinical implications

No frailty assessment tool identified in this review has been developed for use with, nor had its reliability or validity tested in older adult psychiatric populations. Consequently, the

evidence-base for each frailty assessment tool lacks interpretability and generalisability in relation to psychiatric populations, significantly increasing the risk of invalid assessment and identification of frailty. Additionally, the risk of invalid frailty assessment in psychiatric populations is increased with the application of frailty assessment tools: i) for which definite construct overlap was observed between assessment items and DSM-5 diagnostic criteria; ii) that include a psychological assessment domain; and iii) include items derived from psychiatric assessments.

Given the established high level of comorbidity of frailty with psychiatric disorders and evidenced associations between psychiatric disorders and frailty, inaccurate assessment of frailty in psychiatric populations holds substantial clinical risks. If frailty is not recognised and treated within this high-risk population, the potential for adverse outcomes including worsening of psychiatric symptoms and delayed psychiatric remission increases.^{13,21,25}

Similarly, if an individual is inaccurately assessed as being frail or pre-frail based on psychiatric symptoms alone, then this could inappropriately or unnecessarily inform treatment planning and provisions. At a wider level, the presence of frailty and psychiatric disorders individually represent increased risks of adverse outcomes including functional decline, institutionalisation and mortality.^{1-5,22} Accurate assessment and thus treatment of frailty in the context of psychiatric disorder is essential in minimising risks of such adverse outcomes and associated increased healthcare service utilisation.

In research terms, the implications of inaccurately assessing frailty are also substantial, including an increased likelihood of the interpretation and reporting of flawed results. There exists the potential to identify a research population as frail based on their mental health symptoms alone, thus limiting the potential to identify a 'true' frail psychiatric population.

358 Considering the established research priorities specific to this population, including the need
359 to develop specialist treatments and preventative interventions, the impact of this is
360 considerable.

361 Further research is necessary to establish a reliable and valid tool to accurately assess frailty
362 in older adults with a diagnosis of psychiatric disorder. Some level of construct overlap and
363 confounding between the indicators of frailty and of psychiatric disorder is inevitable. For
364 example, sarcopenia is widely considered to be a fundamental component of the frailty
365 syndrome, and unintentional weight loss is an established symptom of MDD, both of which
366 are highly related concepts. However, it may be possible to minimise this construct overlap
367 by considering the way that indicators are conceptualised and measured, for example, by
368 defining and measuring the frailty indicator 'slowness' in a way that minimises construct
369 overlap with psychomotor retardation. Future research is required to establish this.

370 Limitations of the review

371 This review has several limitations. The search strategy was completed in February 2017,
372 therefore any potentially relevant studies published after this date were not considered for
373 review. Studies were assessed against inclusion criteria by the lead author (JLS) only,
374 increasing the risk of selection bias. This was minimised by strict adherence to the search
375 strategy and following the PRISMA standards for reporting in systematic reviews. Data
376 extraction concerning the content of frailty assessment tools was also completed by JLS
377 only, however all analysis including assessments of construct overlap were completed by
378 two independent raters. Studies concerning tools that were not explicitly developed to
379 assess frailty were excluded, limiting the scope of this review but deemed appropriate given
380 the multifaceted nature of the frailty presentation. The COSMIN checklist applied also has a

number of limitations (see previous review for discussion of these limitations)²⁶. However, COSMIN is a standardized tool for evaluating the methodological quality of studies examining measurement properties of health-related instruments, so it was deemed appropriate. In establishing construct overlap between frailty assessment tool items and psychiatric indicators, the use of a different set of diagnostic criteria for mental illnesses such as the 10th revision of the International Statistical Classification of Diseases and Related Health Problems (ICD-10)¹³⁴ may have produced variation in the areas of construct overlap identified. Due to the large volume tools reviewed, it was not possible to apply two separate sets of diagnostic criteria. As the DSM-5 provides in-depth descriptions of diagnostic criteria and is widely used, it was considered appropriate. Finally, whilst the majority of construct overlap observed was due to actual construct overlap; a small amount could be attributed to ambiguous wording of the frailty assessment tool items. For example, the term “problems with” allows for a large range of symptoms to be scored under one item.

Conclusions

To date, no multi-component frailty assessment tool has been developed for or validated in older adult populations with psychiatric disorders. This review has provided an in-depth analysis of construct overlap and confounding between the indicators of frailty as conceptualised in existing frailty assessment tools and DSM-5 diagnostic criteria for seven common psychiatric disorders. In designing a tool for use with older adults with a diagnosis of psychiatric disorder, special consideration should be given, where possible, to minimising the construct overlap identified in this review. Further research is necessary to establish a reliable and valid tool to accurately assess frailty in this specific population.

404

405 **ACKNOWLEDGEMENTS**

406 This research was supported by King's College London, NIHR Dementia Biomedical Research
407 Unit, NIHR Biomedical Research Centre for Mental Health, South London and Maudsley NHS
408 Foundation Trust, University College London and Middlesex University. The views expressed
409 are those of the authors and not necessarily those of the NHS, the NIHR or the Department
410 of Health. The authors would like to express their gratitude and thanks to all those authors
411 who responded to study queries and data requests.

412 Conflict of Interest: All authors declare that they have no conflicts of interest.

413 Author Contributions: The research question, concept and design were formulated by
414 Jennifer L. Sutton, Rebecca L. Gould and Robert J. Howard. The trial selection was
415 completed by Jennifer L. Sutton. Data analysis was completed by Jennifer L. Sutton, Rebecca
416 L. Gould, Mark C. Coulson, Emma V. Ward, Aine M. Butler, Megan Smith, Grace Lavelle, Amy
417 Rosa and Margret Langridge. Preparation of manuscript completed by Jennifer L. Sutton.
418 Rebecca L. Gould, Robert J. Howard, Mark C. Coulson, Emma V. Ward, Aine M. Butler,
419 Megan Smith, Grace Lavelle, Amy Rosa and Margret Langridge reviewed and edited the
420 manuscript.

421 Sponsor's Role: None.

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Figure legends:

Figure 1: Process of study selection

Supplementary material:

Supplementary data file 1: Expanded explanation of study selection criteria

Supplementary data file 2: PRISMA checklist

Supplementary table 1: General characteristics of studies

Supplementary table 2: Results of COnsensus based Standards for the selection of health Measurement Instruments (COSMIN) Checklist^{27,39,40}

Supplementary table 3: Definite construct overlap between multi-component frailty assessment tools and DSM-5 diagnostic criteria²⁹ for seven psychiatric disorders

Supplementary table 4: Definite construct overlap between existing multi-component frailty assessment tools and DSM-5 diagnostic criteria for Major Depressive Episode²⁹

Supplementary table 5: Definite construct overlap between existing multi-component frailty assessment tools and DSM-5 diagnostic criteria for Bipolar Affective Disorder²⁹

Supplementary table 6: Definite construct overlap between existing multi-component frailty assessment tools and DSM-5 diagnostic criteria for Schizophrenia²⁹

Supplementary table 7: Definite construct overlap between existing multi-component frailty assessment tools and DSM-5 diagnostic criteria for Generalised Anxiety Disorder²⁹

Supplementary table 8: Definite construct overlap between existing multi-component frailty assessment tools and DSM-5 diagnostic criteria for Social Anxiety Disorder²⁹

Supplementary table 9: Definite construct overlap between existing multi-component frailty assessment tools and DSM-5 diagnostic criteria for Specific Phobia²⁹

Supplementary table 10: Definite construct overlap between existing multi-component frailty assessment tools and DSM-5 diagnostic criteria for Panic Disorder²⁹

